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Food Habits of the Cottonmouth in Southern Illinois

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It is apparent from an examination of herpetological literature, that there is a lack of detailed data on food habits of many common snakes. Most studies have been concerned with taxonomy and distribution, and only incidental observations have been made of the dietary patterns of individual species. There are only general statements as to the foods utilized by the cottonmouth (Lueth, 1949, Smith, 1950, and Ditmars, 1936) , such as "usually fish and frogs" or "not confined to cold-bloods but also takes birds and mammals." Schmidt and Davis (1941) reported moccasins feeding on large numbers of juvenile turtles in Louisiana, but suggested that, because of the habitat occupied, the diet was largely fish, frogs and other aquatics. Allen and Swindell (1948) recorded representatives of all vertebrate groups, including evidence of cannibalism. Davis (1951) reported an adult mole in the stomach of one specimen. A single quantitative study (Hamilton and Pollack, 1955) provided data on nine specimens from Georgia. By frequency of occurrence, reptiles and amphibians yielded 44.4 per cent whereas mammals occurred in 11.1 per cent of the specimens ; fishes were not recorded.

Since 1950, efforts have been made to study the general ecology and life history of several southern Illinois herpetological species. This paper represents an analysis of the food habits of the cottonmouth, *Ancistrodon piscivorous leucostoma* Troost (Schmidt, 1953) , and is a contribution from Project No. 52 of the Cooperative Wildlife Research Laboratory. The most able assistance of Mrs. Frances Newsome in the identification of food items, and the collecting of snakes by the various members of the Laboratory, is gratefully acknowledged.

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While conducting research activities and class field trips (1950-1957) numerous specimens of the cottonmouth have been collected adults were represented in sufficient numbers to warrant an analysis of the dietary pattern. All specimens were from the lowlands of the Mississippi River with the bulk being captured in the Pine Hills Area, a spring-fed woodland swamp. Except for a few DOR specimens, most snakes were taken alive and killed upon reaching the laboratory. Digestive tracts were removed and preserved in 10 per cent formalin until examined. Prior to examination, the digestive tracts were slit lengthwise and the contents removed by a forceful stream of water while held over a metal milk strainer. Contents were placed in medium-size finger bowls and examined with a dissecting microscope.

Aids in identification of food items included reference collections of representative animal specimens plus slides of hairs, feathers, and scales prepared for most of the southern Illinois forms. The volume of individual food items was determined by water displacement and recorded in cubic centimeters. Average frequency was arrived at by relating total frequency of an individual food item to the number of digestive tracts containing food.

A total of 104 digestive tracts of *Å. piscivorous* were collected (Table 1) , representing April (10) , May (11) , June (17) , July (21) , August (17) , September (16) and October (12) . Of these, 84 yielded sufficient evidence to provide data on individual food habits. Among the 20 empty digestive tracts, 4 were recorded in April, 3 in July, 4 in August, 4 in September, and 5 in October (Table 1) .

Table 1. Numbers of Digestive Tracts and Food Volume by Months for *Ancistrodon piscivorous*.

Month	Food Volume		Digestive Tracts		
	Total	Average	Total	With Food	Empty
April	625	104.1	10	6	4
May	950	86.3	11	11	0
June	1095	64.6	17	17	0
July	1200	66.6	21	18	3
August	1299	99.9	17	13	4
September	1125	93.7	16	12	4
October	1210	172.8	12	7	5
TOTALS	7509	89.4	104	84	20

Fishes (31.9%) yielded the greatest volume of food (Fig. 1 and Table 2) followed by amphibians (26.0%), reptiles (18.2%), mam-

mals (17.9%) , gastropods (1.0%) , and miscellaneous items (5.0%) . Collectively, the cold-blood vertebrates made up 76.1 per cent of the total food volume. Frequency of occurrence and average frequency of the various food groups tended to show the same general relationships as reflected by the volumes.

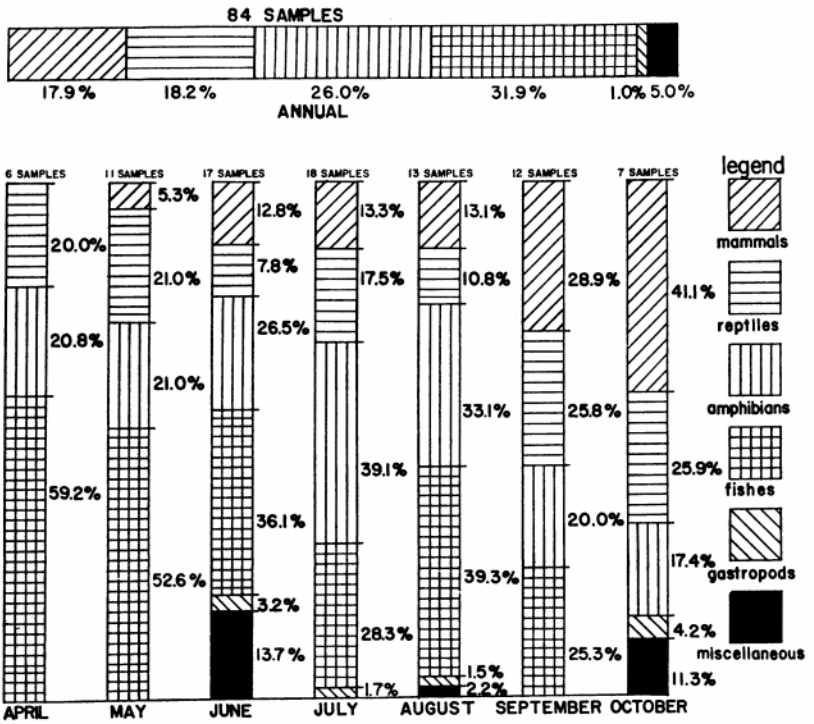

Fig. 1 Monthly and yearly dietary patterns of *Ancistrodon piscivorous* from southern Illinois.

Suspected to be representatives of secondary (Neill and Allen, 1956) and accidental ingestion were certain insects (particularly Hymenoptera) , Arachnida and algae. The occurrence of 1 to as many as 50 mites could be associated with the presence of both reptiles and mammals in the digestive tract. Although a similar interpretation could be made with regard to the Gastropoda (snails) , sufficient evidence was

available to suggest that these frequently represented a primary food. For example a single cottonmouth taken in 1950 contained both shad and snails which showed little evidence of digestion, indicating recent ingestion. Also included was a large quantity of filamentous algae which probably was taken accidentally during the feeding on shad and snails as these forms of food frequently occurred where there were dense mats of algae. Undoubtedly where mammals, reptiles and fish may have been identified on the basis of hairs or scales, respectively, these may have occasionally represented secondary ingestion as they are food items which occur in the diets of a number of the representatives of the various vertebrate groups. This was not believed to have occurred with any great frequency, however.

An analysis of the seasonal aspects of the diet of the cottonmouth suggested that there was no clear-cut trend in the utilization of specific food groups (Fig. 1) . Each major food group tended to vary throughout the months represented with only slight indications of a pattern in this variation. Fishes showed the greatest per cent volume during April and May, decreasing generally, with the exception of August, through the remaining months, and being entirely absent in the diet during October. Mammals, on the other hand, revealed a reverse trend, being absent during April and increasing slightly each month with the greatest volume recorded in October. The utilization of amphibians was quite uniform except for June, July and August when their appearance in the diet increased in volume by 25 to 90 per cent. Reptilian foods presented a trend almost the reverse of that of amphibians, but it was somewhat less clear-cut.

An attempt was made to correlate the utilization of fishes with the known composition of the fish population of the Pine Hills Area ; 46 specimens of *A. piscivorous* were available for this analysis. Gunning and Lewis (1955) in a study of the fishes of this area, recorded the pirateperch (35.7%) , mudminnow (17.2%) , starhead topminnow (14.2%), spring cave-fish, *Chologaster papilliferus,* (7.8%), pigmy sunfish (7.1%) , small sunfish (5.0%) , and mud pickerel, *Esox vermiculatus,* (2.1%) as the most abundant forms in this environment. On the basis of frequency of occurrence, this study of food habits revealed that small sunfish, green sunfish, black crappie, bullhead, mudminnow, starhead topminnow and pigmy sunfish were taken by the cottonmouth somewhat in proportion to their per cent composition of the population of this aquatic environment. Further, their use was in accordance with

Table 2. Qualitative and Quantitative Analysis of Food Items Utilized by *Ancistrodon piscivorous*, April - October, Southern Illinois. (84 Samples)

Food Items	Number of Samples In Which Item Occurred	Percent Frequency of Occurrence	Total Frequency	Average Frequency	Total Volume (Cu. Cent.)	Percent Volume
Pisces	33	39.3	197	2.34	2400	31.9
Dorosoma cepedianum	8		64		630	
Ameiurus spp.	10		35		500	
Lepomis symmetricus	5		37		470	
Lepomis cyanellus	8		22		350	
Aphredoderus savanus	2		20		200	
Pomoxis nigro-maculatus	2		10		150	
Fundulus dispar	1		3		50	
Umbra limi	1		4		40	
Elassoma zonatum	1		2		10	
Amphibia	31	36.9	170	2.02	1955	26.0
*Rana cat*sbeiana*	6		41		500	
Rana clamitans	6		25		415	
Acris gryllus	9		50		370	
Rana pipiens	5		29		245	
Diemictylus viridescens	3		13		150	
Eurycea longicauda	2		5		140	
Rana palustris	2		4		80	
Eurycea lucifuga	2		3		55	
Reptilia	21	25.0	23	0.27	1365	18.2
Natrix sp.	3		5		485	
Thamnophis sp.	7		6		420	
Chelydra serpentina	3		4		200	
Pseudemys scripta	2		2		120	
Ancistrodon piscivorus	2		2		80	
Terrapene carolina	2		3		60	
Unidentified	1		1		Tr.	
Mammalia	26	30.9	24	0.29	342	17.9
Ondatra zibethica	3		5		520	
Microtus ochrogaster	4		9		385	
Unidentified	8		8		337	
Oryzomys palustris	1		2		100	
Gastropoda	15	17.8	61	0.72	75	1.0
Miscellaneous	21	25.0	40	0.48	372	5.0
Algae	5					
Arachnida	4					
Araneae						
Acarina						
Aves	1					
Insecta	3					
Unidentified						
Hymenoptera						
Lepidoptera						
Unidentified	5					

availability, as most of the forms in the diet of the cottonmouth were those that would most frequently occur in the less resticted water areas, rather than the springs and the small streams which supplied the water for this site. Of considerable interest was the fact that shad, although represented in the diet of the cottonmouth, did not appear in the samples of the previous study of the fish population. The occurrence of shad was restricted to two specimens taken in this environment which were captured on the same date from logs in the interior of the swamp area. One specimen contained 29 shad measuring 2/ to 3 inches in length while the other yielded 9 similar fish.

Utilization of the individual food items as represented by the various vertebrate groups (Fig. 1 and Table 2) might be related not only to availability but also to food preference. Conceivably, at the time of emergence of this snake from hibernation, fishes were the more abundant food available, whereas amphibians and mammals, possibly representing a more preferred food, did not become increasingly available until young-of-the-year began to appear. Inasmuch as the bullfrog and the greenfrog yielded the major segments of the amphibian diet, their occurrence in the dietary pattern of the cottonmouth is correlated with their appearance in the water area for breeding and with that of young frogs. Most species of amphibians could be expected to show an increase in population during the late spring and summer as this represents the most active period of transformation from the tadpole to the adult stage. It is of interest to point out that no tadpoles were found in the diet of the cottonmouth. The occurrence of two young cottonmouths supports the evidence of cannibalism reported by Allen and Swindell (1948).

Because the cottonmouth is primarily nocturnal in its feeding habits, its diet must necessarily reflect those animals that are active at this time. This would then preclude its utilization of many animals such as insects or birds. Conceivably, high temperatures would have less effect on this species' than on terrestrial forms (Klimstra, 1958) as a moist, cooler environment would involve greater freedom in feeding activities. However, its nocturnal habits would tend to cancel this factor.

It might be assumed that this species, which retains the eggs from inception to the birth of the young, would require a continuous food supply, thus reflecting a greater uniformity in total volume throughout the year. This, however, was not evidenced by the data, as the average

total volume of food by month showed a trend of 104.1 cubic centimeters in April to a low of 64.6 in June and 66.6 in July to a high of 172.8 in October (Table 1) . However, empty digestive tracts showed evidence of being related to annual reproduction. During July, August and September females represented 63 per cent of the empty tracts. Of these adults, 62 per cent were gravid when examined, suggesting a possible correlation of birth of young with an increase in the occurrence of digestive tracts without food. Also an increase in volume of foods eaten by these females which were carrying young was not evident (Table 1) ; rather there was a reverse in this trend.

The occurrence of empty digestive tracts possibly suggested some correlation with hibernation as 4 were recorded in April, none in May or June, and 3 to 5 for each of the months from July to October. A relationship with emergence from and return to hibernation might here be indicated. Since no animals were taken from hibernating dens, it was not possible to state positively that at this time these animals did not contain food, as has been reported for some of the mammalian forms which hibernate.

As is typical of most animals, food utilization by this snake tended to reflect the ecological niche to which it is adapted, for a close correlation with expected availability of food items in the habitat occupied was obvious. The dietary pattern of the cottonmouth did' not suggest the extreme aspects of annual and seasonal trends in foods utilized as so frequently is observed with many species of vertebrates. Regular windfalls, such as represented by insects which so frequently rate high preferences by many terrestrial snakes, or periodic increases of other prey species, were not reflected in the dietary pattern of the cottonmouth. An analysis of the per cent volume of each major food group (Fig. 1) indicates this uniformity in availability, although the lack of fish in the diet during October might invalidate such a conclusion. However, the absence of fish in October and the increased use of mammals at this time may have reflected the movement from the swamp to den sites in an adjacent precipitous sandstone bluff. Because the bulk of the specimens examined was taken from areas which were represented by spring-fed and hence relatively stable water levels, the availability of food might be expected to show a similar stability throughout the year. It might be reasoned that, despite the lack of periodic influxes of acceptable and available foods, such environments offer greater assurance than

terrestrial habitats of a satisfactory food supply. From this aspect, then, inhabitants of such a niche might have greater security.

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